U.S. Fish and Wildlife Service
Office of Subsistence Management
Fisheries Resource Monitoring Program

Abundance and run timing of adult salmon in the Kateel River, Koyukuk National Wildlife Refuge, Alaska 2002

Annual Report No. FIS 01-038-2

This report has been prepared to assess project progress. Review comments have not been addressed in this report but will be incorporated into the final report for this project.

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Annual Report Summary Page

Title: Abundance and run timing of adult salmon in the Kateel River, Koyukuk National Wildlife Refuge, Alaska 2002.

Study Number: FIS 01-038-2

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Management Regions: Yukon River

Information Type: Stock status and trends of chinook and summer chum salmon

Issues(s) Addressed: The abundance and run timing of spawning populations of salmon within the Yukon River drainage is one of many issues identified specifically by various Regional Advisory Councils and is also stated in the Yukon River Comprehensive Management Plan for Alaska. Even though there has been an increase in escapement data from the Koyukuk River drainage, many tributaries remain unstudied. Chinook and summer chum salmon escapement counts from the Kateel River may assist managers in making decisions during in-season run activity with the intent to provide post season evaluation of various management practices and potentially assisting in developing future run projections.

The objective for this project was to identify spawning populations within the Kateel River drainage. The use of a resistence board weir permitted the collection of data from chinook and summer chum salmon that addresses run size and timing, age composition, sex ratios, and length distribution of spawning salmon. In addition, this information is used to close the information gap among other projects along the Koyukuk River.

Study Cost: $59,600 **Study Duration:** May 2002 to March 2003

Key Words: subsistence fishery, chinook salmon, *Oncorhynchus tshawytscha*, chum salmon, *O. keta*, Yukon River drainage, Koyukuk River, Kateel River, spawning adults, stock status/trends, escapement, resistence board weir.

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Abundance and run timing of adult salmon in the Kateel River, Koyukuk National Wildlife Refuge, Alaska 2002

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Abstract.—A resistance board weir was operated from June 23 to July 27, 2002. This was the second year of a multi-year study to collect biological information on chinook *Oncorhynchus tshawytscha* and summer chum salmon *O. keta* migrating into the Kateel River watershed. A total of 73 chinook and 2,853 summer chum salmon passed through the weir. The most abundant resident species passing through the weir were whitefish *Coregonus spp.* (N=13), followed by longnose suckers *Catostomus catostomus* (N=6), Arctic grayling *Thymallus arcticus* (N=4), and northern pike *Esox lucius* (N=3). The median passage date for chinook salmon was July 12, 2002. Female chinook salmon comprised 31%, with age class 1.4 dominating (50%). The chinook female mean length was 710 mm with a range from 515 mm to 865 mm MEL. The chinook male mean length was 596 mm with a range from 410 mm to 845 mm MEL. The median passage date for summer chum salmon was July 11, 2002. Female summer chum salmon comprised 41%, with age class 0.3 dominating (58%). The summer chum female mean length was 555 mm with a range from 380 mm to 650 mm MEL. The summer chum male mean length was 587 mm with a range from 450 mm to 670 mm MEL.

Introduction

Chinook *Oncorhynchus tshawytscha* and chum *O. keta* salmon spawning in the Kateel River contribute to the subsistence and commercial fisheries within the Yukon River drainage. Chinook salmon enter the Yukon River in mid June and continue through early July. Summer chum salmon enter the Yukon River in mid June, while fall chum salmon enter in late July or early August. Spawning chinook salmon utilize tributaries along the entire Yukon River, while the summer chum salmon utilize those tributaries along the lower and middle areas of the Yukon River. Recent declines of Yukon River salmon stocks, particularly summer and fall chum salmon (Bergstrom et al. 1995; Kruse 1998; JTC 2001), have led to harvest restrictions, subsistence fishery closures, and spawning escapements below management goals. Accurate escapement estimates are required to determine the exploitation rates, marine survival rates, and spawner recruit relations of Pacific salmon stocks (Labelle 1994). In addition, healthy salmon escapements to individual tributary spawning areas are required to maintain genetic diversity and sustainable harvests. Management of salmon populations within the Yukon River is complicated due to the mixed stock nature of this fishery (Tobin and Harper 1998).

In an effort to understand the mixed stock fishery within the Yukon River there are multiple tributary and mainstem escapement studies conducted each year to provide fishery managers with an indication of run strength for chinook and chum salmon stocks. Historically, the Alaska Department of Fish and Game, Division of Commercial Fisheries (ADF&G-DCF) has conducted and compiled a data base on relative abundance of salmon stocks from many tributaries in interior Alaska. This database is primarily made up of aerial surveys (Barton 1984), which are highly variable and are used to estimate spawning strength. More in-depth studies along the lower Yukon River provide managers with information required to assess the in-season run (Vania and Golembeski 2000). These studies include the Emmonak test fishery, subsistence and commercial harvest reports, Pilot station sonar, and the East Fork Andreafsky River weir. In addition, there are studies along the middle portion of the Yukon River that record stock status and trends of salmon populations. These studies include the pilot radio telemetry study on the Innoko River, the Anvik River sonar study, the Nulato River counting tower study, the Gisasa River weir study, the Clear Creek-Hogatza River counting tower study, and the Henshaw Creek weir study.

There are various studies conducted on the Koyukuk River that monitor escapement counts using fish weirs and counting towers. The information gathered from these studies provides escapement data to federal and state mangers during the run in-season. These stock status and escapement projects include the Gisasa River weir study (1994-2001), the South Fork Koyukuk River weir study (1996-1997), the Clear Creek-Hogatza River counting tower study (1995-2001), the Henshaw Creek counting tower study (1999), and the Henshaw Creek weir study (2000-2001).

To increase the understanding of Koyukuk River salmon resources, a resistance board weir project was installed on the Kateel River in 2002. The Kateel River is one of many tributaries flowing into the Koyukuk River drainage on the Koyukuk National Wildlife Refuge (Refuge). The Refuge is located on the lower Koyukuk River near the villages of Koyukuk, Galena, Huslia, and Hughes. The communities located down river on the Koyukuk and Yukon Rivers depend on both salmon species for subsistence use. In accordance with the Alaska National Interests Lands Conservation Act of 1980, the Refuge was established to fulfill many goals and objectives. As part of their goals it is their responsibility to conserve fish and wildlife populations, maintain habitats in their natural diversity and provide the opportunity for continued subsistence use by local residents (USFWS 1993). Obtaining accurate escapement and stock assessment estimates from adult salmon are important components in refining fishery management practices and fulfilling Congressional mandates.

The upper reaches of the Kateel River, as well as other tributaries of the Koyukuk River, provide spawning and rearing habitat for chinook and chum salmon (USFWS 1993). Aerial survey estimates for escapement in the Kateel River have been conducted intermittently since 1960 (Appendix 1; Barton 1984; ADF&G, unpublished data). The Kateel River has been classified as a secondary index stream for chinook and chum salmon (ADF&G 1998). With the use of a resistance board weir, biological information can be collected from both salmon species. The information collected will be used to meet issues identified by the Regional Advisory Councils and specific actions stated in the Yukon River Comprehensive Management Plan for Alaska.

The 2002 objectives of the Kateel River weir study were to: 1) determine daily escapement and run timing of adult salmon, 2) determine age, sex, and length compositions of adult salmon, and 3) determine the movement of non salmon species as they moved through the weir.

Study Area

The Kateel River is a small, clear water tributary of the Koyukuk River located in north-central Alaska (Figure 1). The headwaters of the Kateel River drain the western and northern areas of the Refuge and are located in the Nulato Hills (USFWS 1993). The climate characteristics of this area are cold and continental, which is characterized by extreme seasonal temperature variations and very low precipitation. There is an extreme range in air temperature, with recorded temperatures ranging from 32° C in summer months to lows of -59° C in winter months (USFWS 1993). Stream flows are highest during the spring months in response to snowmelt with sporadic high discharge periods throughout the summer months in response to local rain showers (USFWS 1993).

The channel configuration on the Kateel River is typically meandering with alternating cut banks and gravel bars. The substrate varies from gravel and cobble in high velocity areas to mud and silt in lower velocity areas. The lower stream channel is more uniform in appearance with gradual sloping mud banks and emergent shoreline vegetation (USFWS 1993). The weir site is located approximately 47 km upstream from the mouth of the Kateel River. The width of the channel at the weir site averages 31 m with an average depth of 0.6 m. The substrate composition at the weir site is consists of large gravel to small cobble (50-150 mm).

Methods

Weir Operation.—A resistance board weir was operated to collect biological information from adult salmon and resident species as they migrated up the Kateel River. Construction and installation methods for operating a resistance board weir were described by Tobin (1994). Each picket of the weir was schedule 40 polyvinyl chloride (PVC) electrical conduit with 2.5 cm inside diameter and spaced 3.2 cm apart, from center to center, between individual pickets (Wiswar 2001). Visual inspection of the weir was conducted on a daily basis for holes and structural integrity. During visual inspection the weir was cleaned of debris and fish carcasses. A live trap installed near mid-channel allowed migrating salmon and resident species to pass through the weir.

Biological Data.—Run timing and the abundance of adult salmon were estimated by recording and plotting the number of each species of fish migrating through the weir each day. Run timing was described by quartiles, i.e. first quartile is represented as the 25th percentile of the run passing through the weir, middle quartile as the 50th percentile of the run passing through the weir, and the third quartile as the 75th percentile of the run passing through the weir. Daily counts began at 0800 hours and ended at 2400 hours, with the trap being closed from 2400 to 0800 hour to prevent upstream passage during unmonitored times. The counting schedule was divided into two 8 hour time periods with two crew members recording biological data during each period. For example, between 0800 and 1600 the first two-person crew would record biological data, and from 0400 to

2400 a second two-person crew would record biological data.

Data Analysis.—A stratified random sampling scheme was used to collect age, length, and sex ratio information from both adult salmon species. Biological data was not collected from non-salmon species. Calculations for sex and age information were treated as a stratified random sample (Cochran 1977) with statistical weeks as the strata. Each statistical week was defined as beginning on Monday and ending on Sunday. Sampling started at the beginning of each week and was generally conducted over a 3-4 day period to collect the targeted 160 fish/species. Daily sex ratios were collected using two methods: 1) salmon was sexed when sampling for age and length, and 2) salmon was sexed during counts throughout the day. To record sex ratios throughout the day, crew members would physically handle the fish and sex them as they migrated into the trap. Scale samples were used for aging salmon and reported using the European technique (Foerster 1968). Three scales were collected from chinook samples and one scale from chum salmon. Scales were sampled from the area located on the left side of the fish and two rows above the lateral line on a diagonal line from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin. Scales from both adult salmon species were sent to ADF&G-DCF for processing. Lengths of chinook and chum salmon were measured to the nearest 5 mm from mid eye to fork of the caudal fin (MEL).

Within a week, the proportion of the samples composed of a given sex or age, p_{ij}, were calculated as

$$p_{ij} = \frac{n_{ij}}{n_j},$$

where n_{ij} is the number of fish by sex i or age i sampled in week j, and n_j is the total number of fish sampled in week j. The variance of p_{ij} was calculated as

$$v(p_{ij}) = \frac{p_{ij}(1 - p_{ij})}{n_j - 1}.$$

Sex and age compositions for the total run of chinook and chum salmon of a given sex/age, p_i, were calculated as

$$p_i = \sum_{j=1} W_j p_{ij} ,$$

where the stratum weight (W_j) was calculated as

$$W_j = \frac{N_j}{N},$$

and N_j equals the total number of fish of a given species passing through the weir during week j, and N is the total number of fish of a given species passing through the weir during the run. Variance of sex and age compositions for the run was calculated as

$$v(p_i) = \sum_{j=1} W_j^2 v(p_{ij}) .$$

Results

Weir operation.— Operation of the weir began on June 23 and continued through July 27, 2002. During the course of the study there were multiple rain events that raised the water level high enough to cause problems. During installation the water level was 35 cm until local rain showers raised the water level to more than 120 cm during the course of the field season. During these high flows the crew made adjustments to the weir to prevent fish from passing over or around the weir. Additional weir panels were constructed and installed on the weir and sand bags were filled and placed around the base rails and bulk head to keep the weir fish tight. From July 24-27 the daily escapement counts were below 1% and the water level was above 100 cm. Due to the combination of low salmon counts and high water levels the study was terminated on July 28, 2002.

Biological data.—Summer chum salmon was the most abundant salmon species counted migrating through the weir (N=2,853) followed by chinook salmon (N=73; Figure 2; Table 1). Of the four non-salmon species migrating through the weir, Whitefish *spp.* (N=13) was the most abundant, followed by longnose sucker *Catostomus catostomus* (N=6), Arctic grayling *Thymallus arcticus* (N=4), and northern pike *Esox lucius* (N=3; Table 1).

Chinook salmon. Chinook salmon were first counted on July 5, 2002 and the last chinook counted was on July 25. The first quartile migrated through the weir by July 10 and the median migration date was July 12, 2002 (Figure 2; Table 1).

The chinook salmon seasonal sex composition consisted of 31% females (N=70) with weekly sex composition ranging from 25% to 40% (Table 2). Of the 69 chinook salmon samples used for age composition three were classified as unknown. Age composition of chinook salmon sampled made up three age groups: age 1.4 (50%), age 1.3 (36%), and age 1.2 (14%; Table 3). The average female chinook salmon length was 710 mm with a range from 515 mm to 865 mm MEL (Table 4). The average male chinook salmon length was 596 mm with a range from 410 mm to 845 mm MEL (Table 4).

Summer chum salmon.—Summer chum salmon were first counted on June 26, with a daily passage of two fish, and the last summer chum was counted on July 27, with a daily count of 16 fish. The first quartile migrated through the weir by July 9, and the median migration date was July 11, 2002 (Figure 2; Table 1).

The summer chum salmon seasonal sex ratios consisted of 41% females (N=1,398) with weekly sex ratios ranging from 33% to 54% (Table 2). Of the 591 summer chum salmon samples used for age composition 66 were classified as unknown. Age composition of summer chum salmon sampled (N=525) made up three age groups: age 0.5 (4%), age 0.4 (38%), and age 0.3 (58%; Table 3). The average female summer chum salmon length was 555 mm with a range from 380 mm to 650 mm MEL (Table 4). The average male summer chum salmon length was 587 mm with a range from 450 mm to 670 mm MEL (Table 4).

Discussion

Weir operation.— During the 2002 field season the weir on the Kateel River performed quite well and was effective in both passing fish and collecting biological information. The pickets within each weir panel were spaced far enough apart to prevent adult chinook and summer chum salmon from passing through the weir. However, small salmon and non-salmon species, i.e. jack chinook and chum salmon, Arctic grayling, northern pike, and whitefish spp., likely passed undetected through the weir.

High water levels can temporarily submerge weir panels (Tobin 1994), causing fish to migrate over and around the weir. During the course of the field season, frequent rain showers caused water levels to raise high enough to affect the integrity of the weir. At the start of the project the water level was not a problem when the weir was installed. From June 25 to July 5 the water level did not affect the counting schedule. From July 5-27 when the water level was above 53 cm, the crew made adjustments to the weir that enabled them to continue recording escapement counts and prohibited fish from passing around and or over the weir. These adjustments included constructing and installing additional weir panels and filling sandbags for placement around the trap, base rails, and bulkheads to reinforce the weir. From July 27-30 the water levels were high enough to submerge the weir panels, which allowed fish to pass undetected.

Biological data.—The salmon data collected from Kateel River can be compared to data collected from other systems. For example, the Gisasa River is a potential system that can be used for comparison purposes. Factors that make this a potential system would be location, 64 km down river from Kateel River, and the collection of data from this system since 1994. The close proximity of these two systems provides fishery managers with the ability to track changes in the biological characteristics of the salmon populations between both rivers. Within each system, sampling portions of a population can provide male/female spawning ratios, length at age data, and age class composition. However sample sizes can adversely affect analysis calculations, making it difficult to compare salmon populations between systems. The Kateel River chinook salmon escapement count was small (N=73), which made it difficult to collect a large sample for comparison purposes. For example, there was no significant difference between statistical weeks for Kateel River chinook salmon sex ratios, due to the large standard errors, which was associated with low sample sizes (Figure 3). Conversely, the Gisasa River chinook salmon sex ratios samples were large enough to show a difference between statistical weeks.

The Kateel River summer chum salmon population was large enough to collect samples for analysis and comparison purposes with Gisasa River summer chum salmon populations. With the exception of the first statistical week on the Kateel River, the Kateel and Gisasa River sex ratios were different between statistical weeks (Figure 4).

Passage and run timing.—The season passage estimate of 73 chinook salmon and 2,853 summer chum salmon at the Kateel River weir does not account for the entire Kateel River spawning populations. There is a possibility that some portion of the salmon population spawn in the lower reaches of the Kateel River and even in the Honhosa River. These portions may be large due to the distance between the mouth of the Kateel River and the weir site location, 47 km. Unfortunately, channel characteristics below the present Kateel River weir site do not fit the requirements for operating a weir as stated by Tobin (1994).

Despite these considerations, the overall run timing of chinook salmon passage at the Kateel River weir was similar to the Gisasa River run timing (Figure 5). The first quartile for the chinook salmon run migrated through the weir on July 10 at both the Kateel and Gisasa River weir sites. The time period between the first quartile and the third quartile was 8 days on the Kateel River and 5 days on the Gisasa River. This suggests that the Gisasa River run was more condensed, during the middle 50% of the run, than on the Kateel River, even though the entire Gisasa River run extended over a longer time period (June 25-July 31).

The run timing of summer chum salmon passage at the Kateel River was different from the Gisasa River run timing. The first quartile for summer chum salmon migrated through the Kateel River weir on July 9 and July 6 at the Gisasa River weir (Figure 6). These results show that the Gisasa River summer chum salmon population had an earlier run timing than the Kateel River population.

Sex ratio.—Production of a spawning population is influenced by the number of female fish that shows up on the spawning grounds. Low numbers of females can negatively affect the production of a system even though environmental factors may be favorable. For example data from the Gisasa River show a range of female/male ratios of 16% (1996) to 43% (1995; VanHatten, unpublished data). The Kateel River chinook salmon sex ratios ranged from 25% to 40%. The summer chum salmon sex ratios were higher at the Gisasa River (51%) than the Kateel River (41%). Given this information the chinook salmon run has the potential for being productive but there are more environmental variables that are needed to make this conclusion. Generally, during the salmon spawning period, there are higher proportions of males during the early stages of the run while the females dominate during the later stages (Beacham and Starr 1982). On the Kateel River, this trend was apparent for summer chum salmon while the chinook salmon run did not show this trend.

Due to the low sample size and lack of time series data from Kateel River chinook and summer chum salmon, comparison of length at age data and age class composition cannot be made.

Conclusion

The operation of a floating weir on the Kateel River is an important management tool for U.S. Fish and Wildlife Service and ADF&G-DCF managers in analyzing and understanding the dynamic characteristics of chinook and summer chum salmon in the Yukon River. The Kateel River may represent a tributary supporting small salmon stocks, which can be more susceptible to over-harvest on a mixed stock fishery, like the Yukon River. Data collected from this tributary can also be used to track changes, if any, with the data collected from other tributaries within the Koyukuk River drainage. Because this was the first year of collecting biological data from the adult salmon populations, present comparisons with other tributaries are still vague. As a longer time-series is developed, more insights into relationships with other salmon stocks may become apparent. Considering the amount of time and money invested in this project it would be beneficial to fishery managers to continue operating the Kateel River weir project for a full salmon life cycle.

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Table1.—Daily and cumulative (chinook and summer chum salmon only) counts of fish passing through the Kateel River weir, Alaska, 2002. (Cum=cumulative). * indicate first, middle, and third quartile of run.

	Chinook salmon		Summer chum salmon		Whitefish Spp.	Longnose sucker	Arctic grayling	Northern pike
Date	Daily	Cum	Daily	Cum	Daily	Daily	Daily	Daily
23-Jun	0	0	0	0	0	0	0	0
24-Jun	0	0	0	0	0	0	0	0
25-Jun	0	0	0	0	0	0	0	0
26-Jun	0	0	2	2	0	0	0	0
27-Jun	0	0	1	3	0	0	0	0
28-Jun	0	0	5	8	0	0	0	0
29-Jun	0	0	2	10	0	0	0	0
30-Jun	0	0	2	12	0	0	0	0
1-Jul	0	0	7	19	0	1	0	1
2-Jul	0	0	11	30	0	0	0	0
3-Jul	0	0	8	38	0	0	0	0
4-Jul	0	0	51	89	0	0	0	0
5-Jul	3	3	94	183	2	0	1	0
6-Jul	0	3	58	241	0	0	0	0
7-Jul	2	5	137	378	0	0	0	0
8-Jul	5	10	269	647	1	1	0	1
9-Jul	7	17	296	*943	0	0	1	0
10-Jul	5	*22	258	1,201	2	1	0	0
11-Jul	10	32	305	*1,506	1	0	0	0
12-Jul	7	*39	221	1,727	0	0	0	0
13-Jul	4	43	211	1,938	1	2	2	0
14-Jul	4	47	196	2,134	0	0	0	0
15-Jul	3	50	91	*2,225	1	0	0	0
16-Jul	0	50	140	2,365	0	0	0	0
17-Jul	4	54	84	2,449	3	1	0	0
18-Jul	3	*57	74	2,523	2	0	0	0
19-Jul	2	59	65	2,588	0	0	0	0
20-Jul	1	60	49	2,637	0	0	0	0
21-Jul	5	65	58	2,695	0	0	0	0
22-Jul	4	69	44	2,739	0	0	0	0
23-Jul	1	70	51	2,790	0	0	0	0
24-Jul	2	72	19	2,809	0	0	0	0
25-Jul	1	73	17	2,826	0	0	0	0
26-Jul	0	73	11	2,837	0	0	0	1
27-Jul	0	73	16	2,853	0	0	0	0
Total	73		2,853		13	6	4	3

Table 2.–-Sex ratios of chinook and summer chum salmon sampled at Kateel River weir, Alaska, 2002. SEs are in parentheses. Season total is calculated from weighted abundance of weekly totals.

Time period	Run size	N	Percent female	Estimated number of females
		Chinook salmon		
June 25-30	0	0	0 (0.0)	0
July 1-7	5	5	40 (24.5)	2
July 8-14	42	39	28 (7.3)	12
July 15-21	18	18	39 (11.8)	7
July 22-26	8	8	25 (16.4)	2
Season total	73	70	31 (5.7)	23
		Summer chum salmon		
June 25-30	12	12	42 (14.9)	5
July 1-7	366	299	33 (2.7)	121
July 8-14	1,756	639	36 (1.9)	632
July 15-21	561	310	52 (2.8)	291
July 22-26	158	138	54 (4.3)	85
Season total	2,853	1,398	41 (1.4)	1,134

Table 3.- Percent weekly age estimates of chinook and summer chum salmon sampled at Kateel River weir, Alaska, 2002. SEs are in parentheses. Season total is calculated from weighted abundance of weekly totals.

Chinook salmon

				Brood year and age		
				1996	1997	1998
Time period	Run size	N	Unknown	1.4	1.3	1.2
June 25-30	0	0				
July 1-7	5	5	0	40 (24.5)	60 (24.5)	0 (0.0)
July 8-14	42	36	1	50 (8.5)	33 (8.0)	17 (6.3)
July 15-21	18	17	2	53 (12.5)	35 (11.9)	12 (8.1)
July 22-26	8	8	0	50 (18.9)	38 (18.3)	12 (12.5)
Season total	73	66	3	50 (6.3)	36 (6.0)	14 (4.4)

Summer chum salmon

				Brood year and age		
				1996	1997	1998
Time period	Run size	N	Unknown	0.5	0.4	0.3
Jun 22-30	12	10	1	0 (0.0)	50 (16.7)	50 (16.7)
Jul 1-7	366	153	11	6 (1.9)	41 (4.0)	53 (4.0)
Jul 8-14	1,756	162	28	4 (1.5)	40 (3.9)	56 (3.9)
Jul 15-21	561	91	13	2 (1.5)	32 (4.9)	66 (5.0)
Jul 22-31	158	109	13	3 (1.6)	36 (4.6)	61 (4.7)
Season total	2,853	525	66	4 (1.0)	38 (2.6)	58 (2.7)

Table 4. -Length at age of female and male chinook and summer chum salmon sampled at Kateel River weir, Alaska, 2002. SE are in parentheses.

	Female				Male			
		Mid-eye to fork length (mm)				Mid-eye to fork length (mm)		
Age	N	Mean	Median	Range	N	Mean	Median	Range
				Chinook salmon				
1.2	4	549 (18.1)	550	515-580	29	539 (9.1)	540	410-625
1.3	9	695 (21.9)	685	590-790	15	673 (12.1)	670	565-730
1.4	6	839 (7.9)	833	820-865	3	765 (41.0)	740	710-845
Total	19	710 (26.9)	740	515-865	47	596 (13.2)	575	410-845
				Summer chum salmon				
0.3	143	549 (2.2)	550	480-650	160	578 (2.6)	575	450-665
0.4	86	562 (3.4)	560	380-625	115	596 (2.6)	600	530-670
0.5	7	581 (15.9)	590	520-630	13	618 (10.2)	615	560-670
Total	236	555 (1.9)	555	380-650	288	587 (1.9)	585	450-670

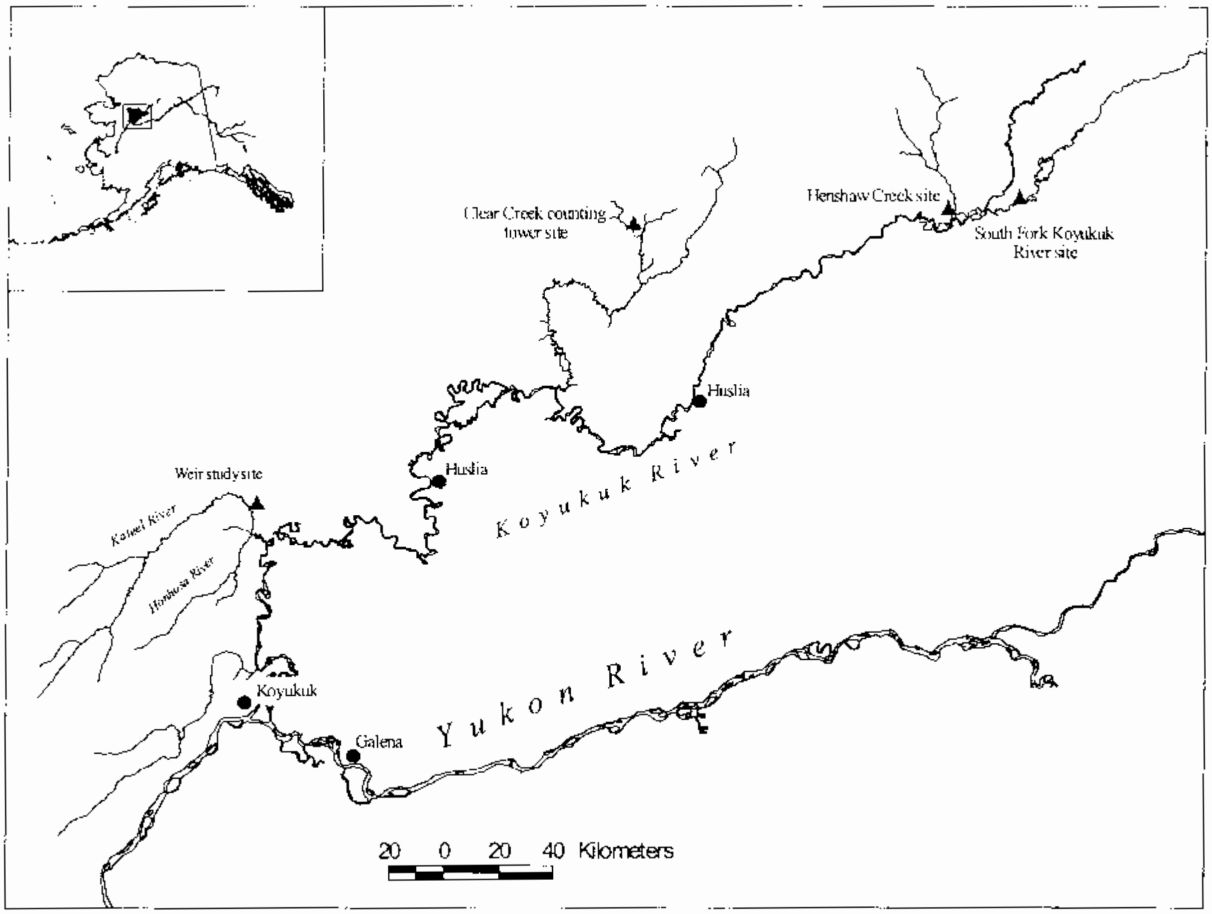

Figure 1.- The Koyukuk River, major tributaries, and escapement study sites, Alaska, 2002.

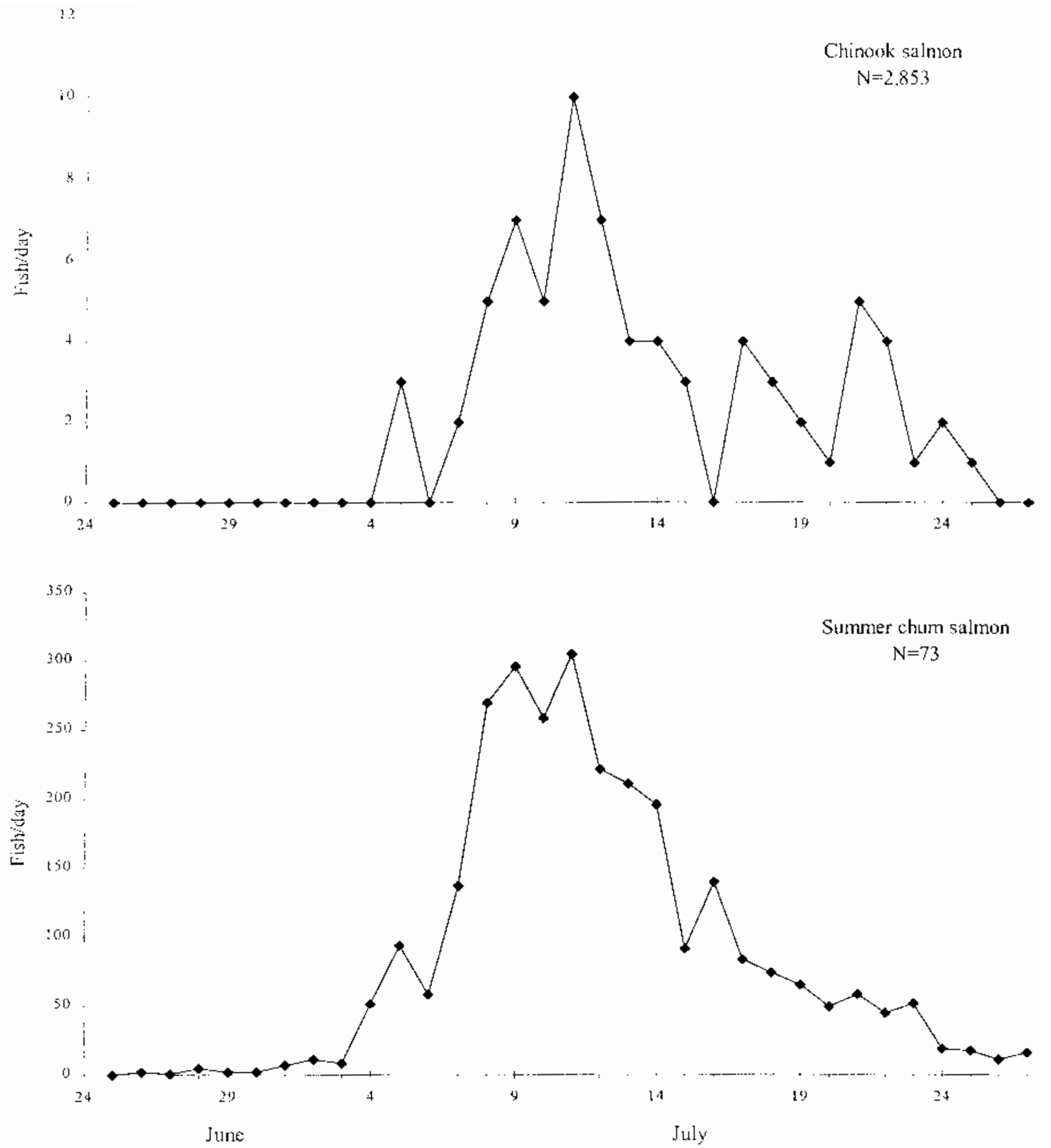

Figure 2.– Daily chinook and summer chum salmon escapement counts recorded at Kateel River weir site, Alaska, 2002.

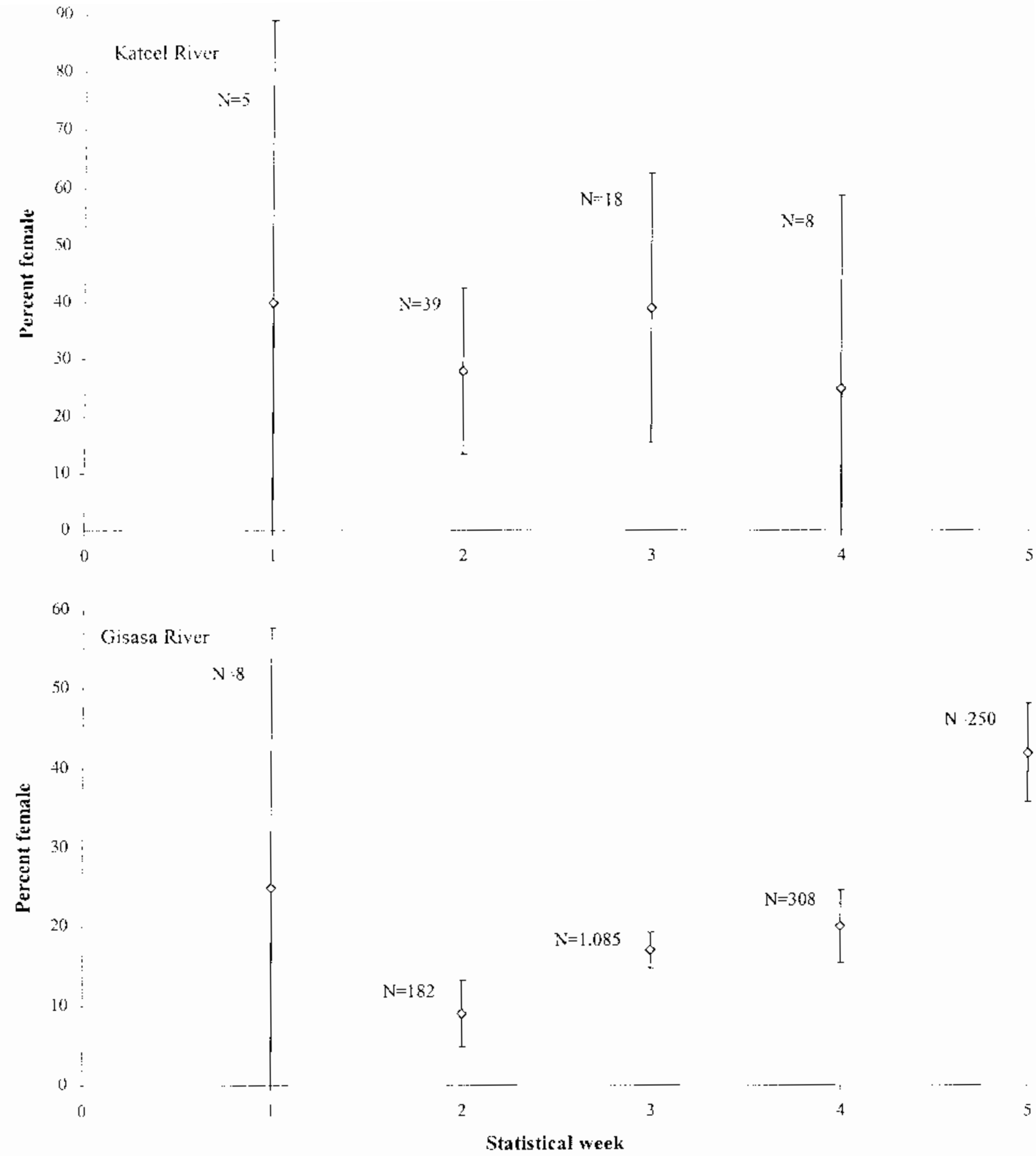

Figure 3. Chinook salmon sex ratios, by statistical week, collected from Kateel and Gisasa River weir sites, Alaska, 2002. Vertical bars represent plus and minus standard error.

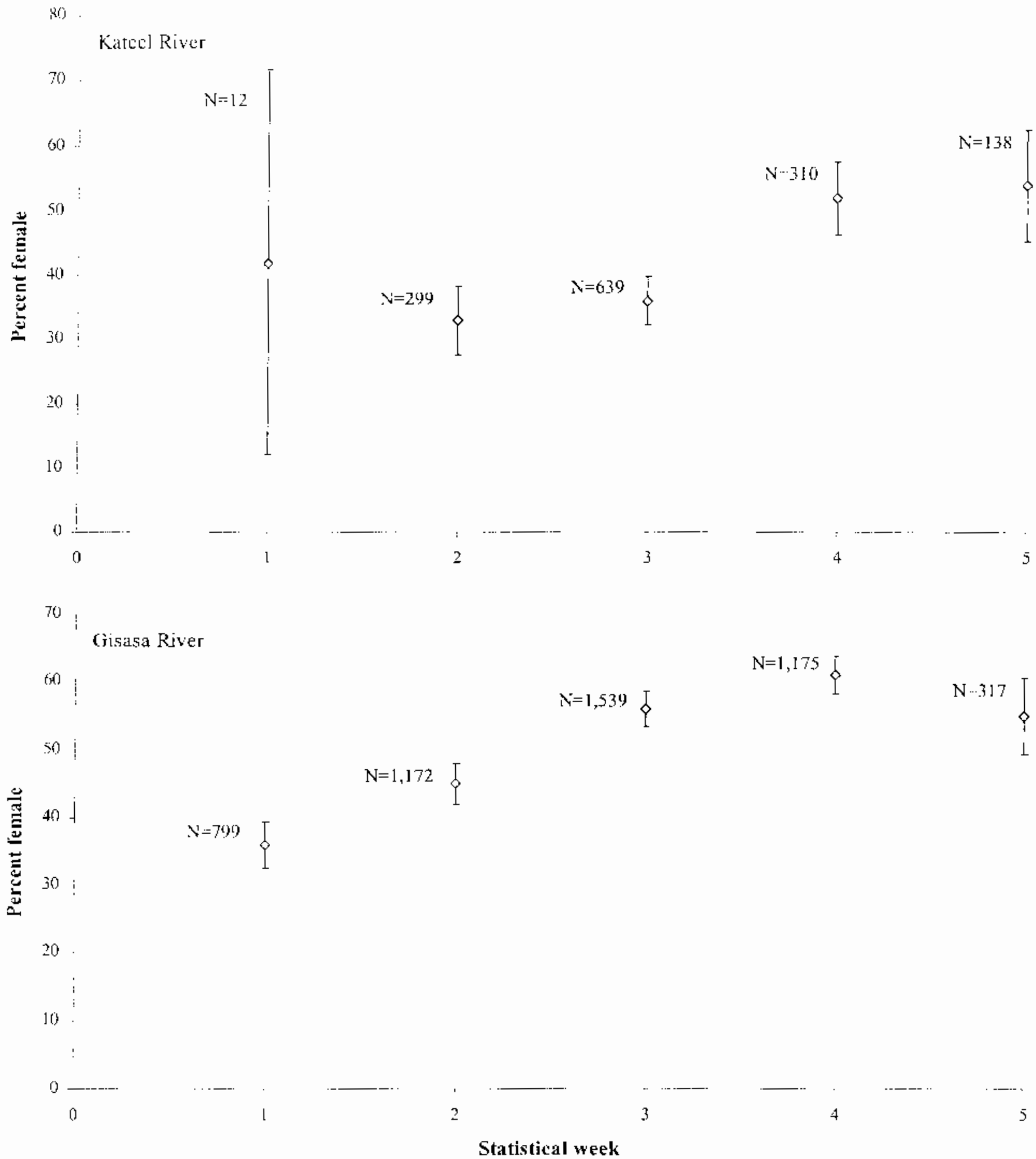

Figure 4.—Summer chum salmon sex ratios, by statistical week, collected from Kateel and Gisasa River weir sites, Alaska, 2002. Vertical bars represent plus and minus standard error.

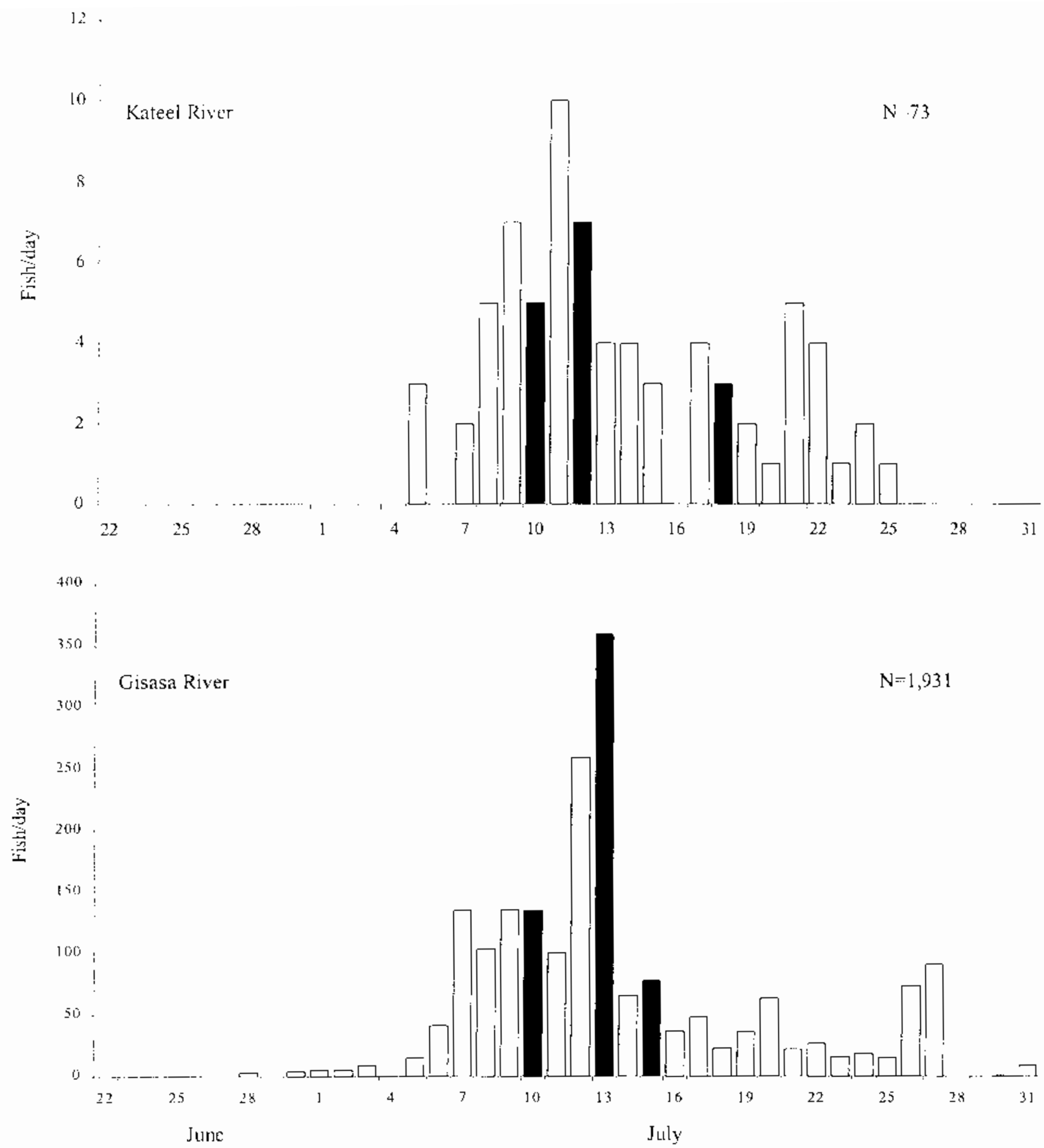

Figure 5.—Daily chinook salmon escapement counts recorded from Kateel and Gisasa River weir sites, Alaska, 2002. Shaded bars represent first, middle, and third quartile of run passing through the weir. Operation of weir from June 23-July 27 for Kateel River and June 23-July 31 for Gisasa River.

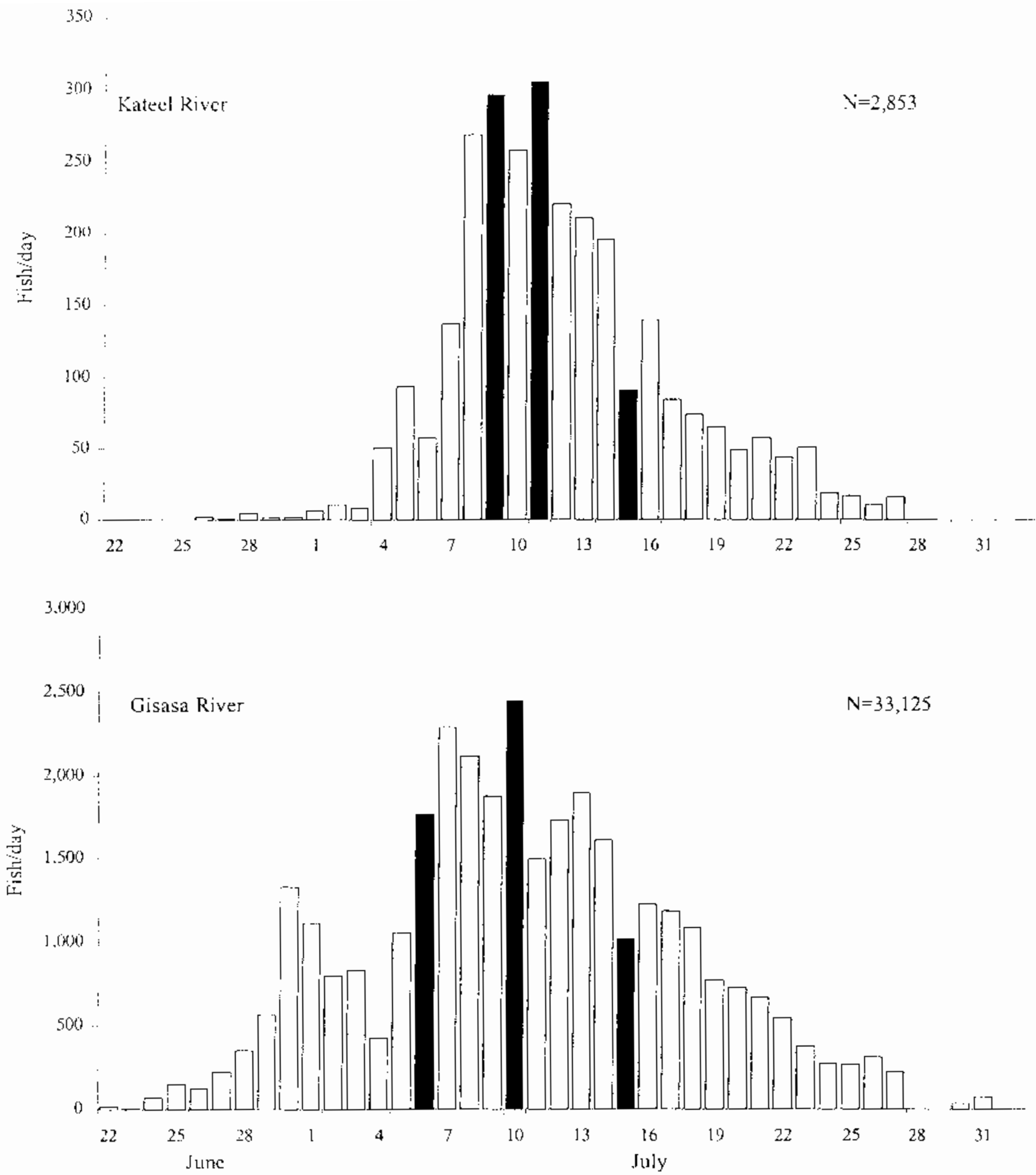

Figure 6.—Daily summer chum salmon escapement counts recorded from Kateel and Gisasa River weir sites, Alaska, 2002. Shaded bars represent first, middle, and third quartile of run passing through the weir. Operation of weir from June 23-July 27 for Kateel River and June 23-July 31 for Gisasa River.

Appendix 1. –Historical chinook and summer chum salmon escapements for Kateel River, Alaska, 1960-2002. All data except floating weir are from Barton (1984) and ADF&G, unpublished data. Aerial index estimates are surveys that are rated at poor, fair, good, or any combination. Ratings are based on a combination of various environmental conditions, i.e. wind, weather, water, visibility, bottom, time, distance surveyed, and spawning stage of the run. There is no aerial survey data for the years 1961-1973, 1977-1979, 1981-1989, 1991, and 1994-2002.

	Aerial index estimates			Floating weir	
Year	Chinook salmon	Summer chum salmon	Rating	Chinook salmon	Summer chum salmon
1960	4	46	Fair		
1974	14	1,661	Fair		
1975	60	8,552	Fair/past peak		
1976	8	238	Fair/at peak		
1980	0	6	Good/before peak		
1990	185	338	Poor		
1992	65	800	Incomplete		
1993	0	0	Poor		
2001				No escapement data	
2002				73	2,853